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Spontaneous pneumothorax

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ABSTRACT

INTRODUCTION: The incidence of spontaneous pneumothorax is 24/100,000 a year in men and 9.9/100,000 a year in women in England and Wales. The major contributing factor is smoking, which increases the likelihood by 22 times in men, and by 8 times in women. While death from spontaneous pneumothorax is rare, rates of recurrence are high, with one study of men in the USA finding a total recurrence rate of 35%. METHODS AND OUTCOMES: We conducted a systematic review and aimed to answer the following clinical questions: What are the effects of treatments in people presenting with spontaneous pneumothorax? What are the effects of interventions to prevent recurrence in people with previous spontaneous pneumothorax? We searched: Medline, Embase, The Cochrane Library, and other important databases up to January 2010 (Clinical Evidence reviews are updated periodically, please check our website for the most up-to-date version of this review). We included harms alerts from relevant organisations such as the US Food and Drug Administration (FDA) and the UK Medicines and Healthcare products Regulatory Agency (MHRA). RESULTS: We found 17 systematic reviews, RCTs, or observational studies that met our inclusion criteria. We performed a GRADE evaluation of the quality of evidence for interventions. CONCLUSIONS: In this systematic review we present information relating to the effectiveness and safety of the following interventions: chest-tube drainage (alone or plus suction), chest tubes (small, standard sizes, one-way valves), needle aspiration, and pleurodesis.

QUESTIONS

INTERVENTIONS

TREATMENTS FOR SPONTANEOUS PNEUMOTHORAX

Likely to be beneficial

Unknown effectiveness

PREVENTING RECURRENCE OF SPONTANEOUS PNEUMOTHORAX

Trade off between benefits and harms

Unknown effectiveness

To be covered in future updates

Aspiration catheter with integral one way valve system (Heimlich valve)

Key points

- Spontaneous pneumothorax is defined as air entering the pleural space without any provoking factor, such as trauma, surgery, or diagnostic intervention.

  Incidence is 24/100,000 a year in men, and 10/100,000 a year in women in England and Wales, and the major contributing factor is smoking, which increases the likelihood by 22 times in men and by 8 times in women.

  While death from spontaneous pneumothorax is rare, rates of recurrence are high, with one study of men in the US finding a total recurrence rate of 35%.

- Overall, we found insufficient RCT evidence to determine whether any intervention is more effective than no intervention for spontaneous pneumothorax.

- Chest-tube drainage seems to be a useful treatment for spontaneous pneumothorax, although RCT evidence is somewhat sparse.

  Small (8 French gauge) chest tubes are generally easier to insert, and may reduce the risk of subcutaneous emphysema, although successful resolution may be less likely in people with large pneumothoraces (>50% lung volume). We don't know whether there is a difference in duration of drainage with small tubes.

  The trials investigating the efficacy of adding suction to chest-tube drainage are too small and underpowered to detect a clinically important difference.

  We don't know whether using one-way valves on a chest tube is more effective than using drainage bottles with underwater seals. There is a suggestion, however, that one-way valves might reduce hospital admission and the need for analgesia.

- It seems that needle aspiration might be beneficial in treating people with spontaneous pneumothorax, although it is not clear whether it is more effective than chest-tube drainage.
- Pleurodesis seems to be effective in preventing recurrent spontaneous pneumothorax, although there are some adverse effects associated with the intervention.

  Chemical pleurodesis successfully reduces recurrence of spontaneous pneumothorax, although the injection has been reported to be intensely painful.

  Thoracoscopic surgery with talc instillation also seems to reduce recurrence of spontaneous pneumothorax, but leads to a modest increase in pain during the first 3 days.

  Video-assisted thoracoscopic surgery, while less invasive than thoracotomy, may be associated with higher recurrence rates.

  We found no RCT evidence examining when pleurodesis should be given, although there is general consensus that it is warranted after the second or third episode of spontaneous pneumothorax.

DEFINITION

A pneumothorax is air in the pleural space. A **spontaneous pneumothorax** occurs when there is no provoking factor — such as trauma, surgery, or diagnostic intervention. It implies a leak of air from the lung parenchyma through the visceral pleura into the pleural space, which causes the lung to collapse and results in pain and shortness of breath. This review does not include people with **tension pneumothorax**.

INCIDENCE/ PREVALENCE

In a survey in Minnesota, USA, the incidence of spontaneous pneumothorax was 7/100,000 for men and 1/100,000 for women. [1] In England and Wales, the overall rate of people consulting with pneumothorax (in both primary and secondary care combined) is 24/100,000 a year for men and 10/100,000 a year for women. [2] The overall annual incidence of emergency hospital admissions for pneumothorax in England and Wales is 16.7/100,000 for men and 5.8/100,000 for women. [2] Smoking increases the likelihood of spontaneous pneumothorax by 22 times for men and by 8 times for women. The incidence is directly related to the amount smoked. [3]

AETIOLOGY/ RISK FACTORS

Primary spontaneous pneumothorax is thought to result from congenital abnormality of the visceral pleura, and is typically seen in young, otherwise fit people. Secondary spontaneous pneumothorax is caused by underlying lung disease, typically affecting older people with emphysema or pulmonary fibrosis. [4]

PROGNOSIS

Death from spontaneous pneumothorax is rare, with UK mortality of 1.26 per million a year for men and 0.62 per million a year for women. [2] Published recurrence rates vary. One cohort study in Denmark found that, after a first episode of primary spontaneous pneumothorax, 23% of people had a recurrence within 5 years, most of them within 1 year. [5] Recurrence rates had been thought to increase substantially after the first recurrence, but one retrospective case-control study (147 US military personnel) found that 28% of men with a first primary spontaneous pneumothorax had a recurrence; 23% of the 28% had a second recurrence; and 14% of that 23% had a third recurrence, resulting in a total recurrence rate of 35%. [6]

AIMS OF INTERVENTION

To reduce morbidity; to restore normal function as quickly as possible; to prevent recurrence and mortality, with minimum adverse effects.

OUTCOMES

Successful **resolution** of spontaneous pneumothorax after a stated period; time to full expansion of the lung; **duration of hospital stay**; time off work; **adverse effects of treatments** (complications including pain, surgical emphysema, wound, and pleural space infection); and **rate of recurrence**.

METHODS

Clinical Evidence search and appraisal January 2010. The following databases were used to identify studies for this systematic review: Medline 1966 to January 2010, Embase 1980 to January 2010, and The Cochrane Database of Systematic Reviews 2009, Issue 4 (1966 to date of issue). An additional search within The Cochrane Library was carried out for the Database of Abstracts of Reviews of Effects (DARE) and the Health Technology Assessment (HTA) database. We also searched for retractions of studies included in the review. Abstracts of the studies retrieved from the initial search were assessed by an information specialist. Selected studies were then sent to the contributor for additional assessment, using predetermined criteria to identify relevant studies. Study design criteria for inclusion in this review were: published systematic reviews of RCTs and RCTs in any language. RCTs had to contain 20 or more individuals of whom 80% or more were followed up. Blinded and non-blinded studies were included. There was no minimum length of follow-up required to include studies. We included systematic reviews of RCTs and RCTs where harms of an included intervention were studied applying the same study design criteria for inclusion as we did for benefits. In addition we use a regular surveillance protocol to capture harms alerts from organisations such as the FDA and the MHRA, which are added to the reviews as required. To aid

readability of the numerical data in our reviews, we round many percentages to the nearest whole number. Readers should be aware of this when relating percentages to summary statistics such as relative risks (RRs) and odds ratios (ORs). We have performed a GRADE evaluation of the quality of evidence for interventions included in this review (see table, p 17). The categorisation of the quality of the evidence (high, moderate, low, or very low) reflects the quality of evidence available for our chosen outcomes in our defined populations of interest. These categorisations are not necessarily a reflection of the overall methodological quality of any individual study, because the Clinical Evidence population and outcome of choice may represent only a small subset of the total outcomes reported, and population included, in any individual trial. For further details of how we perform the GRADE evaluation and the scoring system we use, please see our website (www.clinicalevidence.com).

QUESTION **What are the effects of treatments in people presenting with spontaneous pneumothorax?**

OPTION **NEEDLE ASPIRATION**

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- It seems that needle aspiration might be beneficial in treating people with spontaneous pneumothorax, although it is not clear whether it is more effective than chest-tube drainage.

Benefits and harms

Needle aspiration versus observation:

We found no systematic review. We found one small RCT. [7]

Resolution rates

Compared with observation Needle aspiration may be more effective at increasing resolution rates (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution					
[7] RCT	21 people	**Mean time to full expansion** 1.6 weeks in 8 people successfully treated with needle aspiration 3.2 weeks in 10 people treated with conservative treatment 2 people randomised to needle aspiration required a chest tube	Significance assessment not performed		

Duration of hospital stay

No data from the following reference on this outcome. [7]

Recurrence rates

No data from the following reference on this outcome. [7]

Adverse effects

No data from the following reference on this outcome. [7]

Needle aspiration versus chest-tube drainage:

We found two systematic reviews. [8] [9] The first review (search date 2003, 3 RCTs, [10] [11] [12] 194 people with primary or recurrent spontaneous pneumothorax) [8] compared needle aspiration versus chest-tube drainage. [8] The second systematic review (search date 2006) [9] excluded two of the RCTs [10] [11] identified by the first review because it was unclear whether participants in these RCTs were experiencing a first episode of spontaneous pneumothorax. The second review included one RCT (60 people) [12] identified by the first review and found similar results to the first review.

Resolution rates

Compared with chest-tube drainage We don't know whether needle aspiration is more effective at achieving success rates at 1 week in people with spontaneous pneumothorax (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution					
[8] Systematic review	194 people with primary or recurrent spontaneous pneumothorax 3 RCTs in this analysis	**Success , at 1 week or more** with needle aspiration with chest-tube drainage Absolute results not reported	RR 0.86 95% CI 0.67 to 1.11	⟷	Not significant

Duration of hospital stay

Compared with chest-tube drainage Needle aspiration seems more effective at reducing the duration of hospital stay in people with spontaneous pneumothorax (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hospital stay					
[8] Systematic review	194 people with primary or recurrent spontaneous pneumothorax 3 RCTs in this analysis	**Hospital stay** with needle aspiration with chest-tube drainage Absolute results not reported	WMD –1.3 days 95% CI –2.2 days to –0.39 days P = 0.005	○○○	needle aspiration

Recurrence rates

Compared with chest-tube drainage We don't know whether needle aspiration is more effective at preventing recurrence of spontaneous pneumothorax at 1 year (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Recurrence					
[8] Systematic review	194 people with primary or recurrent spontaneous pneumothorax 3 RCTs in this analysis	**Recurrence , at 1 year** with needle aspiration with chest-tube drainage Absolute results not reported	RR 0.73 95% CI 0.39 to 1.38	⟷	Not significant

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[10] RCT	People with pneumothorax In review [8]	**Mean daily pain scores during their hospital stay** 0.7 with needle aspiration 1.5 with chest-tube drainage Score chart not described further	P <0.001	○○○	needle aspiration
[11] RCT	People with pneumothorax In review [8]	**Pain or dyspnoea** with needle aspiration with chest-tube drainage Absolute results reported graphically Scored on a scale from 1 to 5	Reported as not significant	⟷	Not significant
[9] Systematic review	60 people Data from 1 RCT	**Proportion of people requiring hospital admission , after treatment** 14/27 (52%) with needle aspiration 33/33 (100%) with chest-tube drainage	RR 0.52 95% CI 0.36 to 0.75	●○○	needle aspiration

Further information on studies

[7] The RCT comparing needle aspiration versus observation was published as a letter.

[8] Rates of successful resolution could not be combined by the review because of differences in outcome definitions. Pain and dyspnoea scores could not be combined because of differences in outcome definitions.

[12] The RCT did not assess pain. One of the systematic reviews [9] that identified this RCT stated that it reported no complications in the simple aspiration group, but did not report on complications in the intercostal tube drainage group.

Comment: None.

OPTION CHEST-TUBE DRAINAGE ALONE

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- Chest-tube drainage seems to be a useful treatment for spontaneous pneumothorax, although the evidence is somewhat sparse.

Benefits and harms

Chest-tube drainage versus observation:

We found no systematic review or RCTs.

Chest-tube drainage versus needle aspiration:

See option on needle aspiration, p 3 .

Chest-tube drainage versus chest-tube drainage plus suction:

See option on chest-tube drainage plus suction, p 9 .

Further information on studies

Comment: None.

OPTION SMALL- VERSUS STANDARD-SIZED CHEST TUBES FOR DRAINAGE

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- Small (8 French gauge) chest tubes are generally easier to insert, and may reduce the risk of subcutaneous emphysema, although successful resolution may be less likely in people with large pneumothoraces (>50% lung volume). We don't know whether there is a difference in duration of drainage with small tubes.

Benefits and harms

Small- versus standard-sized chest tubes:

We found no systematic review. We found no RCTs, but found one small non-randomised trial (44 people), which compared small-gauge catheters (8 French gauge) versus standard-sized chest tubes (see further information on studies). [13]

Resolution rates

Small-sized chest tubes compared with standard-sized chest tubes Small-gauge tubes seem less effective at achieving successful resolution in people with large pneumothoraces (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution					
[13] Non-randomised trial	26 people with large pneumothoraces (>50% lung volume) Subgroup analysis	**Proportion of people with successful resolution** 8/14 (57%) with small-gauge catheters (8 French gauge) 12/12 (100%) with standard-sized chest tubes	P <0.05	○○○	standard-sized chest tubes

Duration of hospital stay

No data from the following reference on this outcome. [13]

Recurrence rates

No data from the following reference on this outcome. [13]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[13] Non-randomised trial	44 people	**Subcutaneous emphysema** 0/21 (0%) with small-gauge catheters (8 French gauge) 9/23 (39%) with standard-sized chest tubes	P <0.05	○○○	small-gauge catheters

Further information on studies

[13] The RCT found no significant difference in duration of drainage between groups (5 days with small tubes *v* 6 days with standard chest tubes; reported as not significant, no further data reported).

Comment: **Clinical guide:**
Small-gauge chest tubes are usually easier to insert.

OPTION ONE-WAY VALVES ON CHEST TUBES

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- We don't know whether using one-way valves on a chest tube is more effective than using drainage bottles with underwater seals. There is a suggestion, however, that one-way valves might reduce hospital admission and the need for analgesia.

Benefits and harms

One-way valves on chest tubes:

We found no systematic review. We found one RCT comparing a chest tube (13 French gauge) connected to a one-way valve versus a chest tube (14 French gauge) connected to a drainage bottle with an underwater seal. [14]

Resolution rates

Compared with drainage bottles One-way valves and drainage bottles with underwater seals seem equally effective at improving expansion or nearly complete expansion of the lung at 48 hours in people with spontaneous pneumothorax and respiratory distress (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution					
[14] RCT	30 people with spontaneous pneumothorax and respiratory distress	**Rate of resolution (complete or nearly complete expansion) , 48 hours** 15/17 (88%) with chest tube (13 French gauge) connected to a one-way valve 11/13 (85%) with chest tube (14 French gauge) connected to a drainage bottle with an underwater seal	RR 1.04 95% CI 0.78 to 1.39	⟷	Not significant

Duration of hospital stay

Compared with drainage bottles One-way valves are more effective at reducing hospital admissions in people with spontaneous pneumothorax and respiratory distress (high-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hospital stay					
[14] RCT	30 people with spontaneous pneumothorax and respiratory distress	**Hospital admissions** 5/17 (29%) with chest tube (13 French gauge) connected to a one-way valve 13/13 (100%) with chest tube (14 French gauge) connected to a drainage bottle with an underwater seal	RR 0.29 95% CI 0.14 to 0.61	●●○	chest tube connected to a one-way valve

Recurrence rates

No data from the following reference on this outcome. [14]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[14] RCT	30 people with spontaneous pneumothorax and respiratory distress	**Rates of complications (need for a second drain)** 3/17 (18%) with chest tube (13 French gauge) connected to a one-way valve 1/13 (8%) with chest tube (14 French gauge) connected to a drainage bottle with an underwater seal	Reported as not significant	⟷	Not significant
[14] RCT	30 people with spontaneous pneumothorax and respiratory distress	**Proportion of people who required analgesia** 5/17 (29%) with chest tube (13 French gauge) connected to a one-way valve 10/13 (77%) with chest tube (14 French gauge) connected to a drainage bottle with an underwater seal	RR 0.38 95% CI 0.17 to 0.85	●●○	chest tube connected to a one-way valve
[14] RCT	30 people with spontaneous pneumothorax and respiratory distress	**Rates of complications (skin emphysema)** 3/17 (18%) with chest tube (13 French gauge) connected to a one-way valve 3/13 (23%) with chest tube (14 French gauge) connected to a drainage bottle with an underwater seal	Reported as not significant	⟷	Not significant

Further information on studies

Comment: None.

OPTION CHEST-TUBE DRAINAGE PLUS SUCTION

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- The trials investigating the efficacy of adding suction to chest-tube drainage are too small and underpowered to detect a clinically important difference.

Benefits and harms

Chest-tube drainage plus suction versus chest-tube drainage alone:

We found no systematic review, but found one RCT [15] and one controlled clinical trial [16] comparing chest-tube drainage using an underwater seal only versus drainage plus suction.

Resolution rates

Compared with chest-tube drainage alone Chest-tube drainage plus suction may be no more effective at increasing lung expansion at 10 days in people with primary or secondary spontaneous pneumothorax (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution					
[15] RCT	53 people; 23 with primary and 30 with secondary spontaneous pneumothorax	**Proportion of people with full lung expansion , 10 days** 13/23 (57%) with chest-tube drainage plus suction 15/30 (50%) with chest-tube drainage using an underwater seal only Suction pressures ranged from 8 cm H_2O to 20 cm H_2O	ARI +7% 95% CI –21% to +34% RR 1.13 95% CI 0.68 to 1.88 The RCT is likely to have been too small to detect a clinically important difference	⟷	Not significant
[16] Pseudo-randomised trial Alternate allocation	40 people	**Time taken for lung expansion** 5.2 days with chest-tube drainage with low-pressure suction 6.2 days with chest-tube drainage without suction The trial did not state whether spontaneous pneumothorax was primary or secondary, or what suction pressure was applied	Reported as not significant CI not reported	⟷	Not significant

Duration of hospital stay

No data from the following reference on this outcome. [15] [16]

Recurrence rates

No data from the following reference on this outcome. [15] [16]

Adverse effects

No data from the following reference on this outcome. [15] [16]

Further information on studies

Comment: None.

QUESTION **What are the effects of interventions to prevent recurrence in people with previous spontaneous pneumothorax?**

OPTION **PLEURODESIS**

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- Pleurodesis seems to be effective in preventing recurrent spontaneous pneumothorax, although there are some adverse effects associated with the intervention. Chemical pleurodesis successfully reduces recurrence of spontaneous pneumothorax, although the injection has been reported to be intensely painful. Thoracoscopic surgery with talc instillation also seems to reduce recurrence of spontaneous pneumothorax, but leads to a modest increase in pain during the first 3 days. Video-assisted thoracoscopic surgery, while less invasive than thoracotomy, may be associated with higher recurrence rates.

Benefits and harms

Adding chemical pleurodesis to chest-tube drainage versus chest-tube drainage alone:

We found no systematic review. We found two RCTs. [17] [18]

Recurrence rates

Adding chemical pleurodesis to chest-tube drainage compared with chest-tube drainage alone We don't know whether chemical pleurodesis using tetracycline or talcum powder is more effective at reducing recurrence rates at 30 months or 4.6 years in people with spontaneous pneumothorax (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Recurrence					
[17] RCT Open-label trial	229 men with pneumothorax successfully treated by chest-tube drainage; mean age 54 years; 55% with COPD	**Recurrence rates , over 30 months** 26/104 (25%) with adding intrapleural instillation of tetracycline 44/108 (41%) with chest-tube drainage alone	RR 0.61 95% CI 0.41 to 0.92	●○○	adding intrapleural instillation of tetracycline
[18] RCT **3-armed trial**	96 people treated with chest-tube drainage The remaining arm evaluated tetracycline pleurodesis	**Pneumothorax recurrence rate , 4.6 years** 2/24 (8%) with talcum powder pleurodesis 9/25 (36%) with no further treatment	Difference between talcum powder pleurodesis and no further treatment reported as significant	○○○	talcum powder pleurodesis
[18] RCT **3-armed trial**	96 people treated with chest-tube drainage The remaining arm evaluated talcum powder pleurodesis	**Pneumothorax recurrence rate , 4.6 years** 3/23 (13%) with tetracycline pleurodesis 9/25 (36%) with no further treatment	Difference between tetracycline pleurodesis and no further treatment reported as not significant	⟷	Not significant

Duration of hospital stay

Chemical pleurodesis plus chest-tube drainage compared with chest-tube drainage alone Chemical pleurodesis plus chest-tube drainage may be no more effective at reducing the duration of hospital stay in people with spontaneous pneumothorax (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hospital stay					
[17] RCT Open-label trial	229 men with pneumothorax successfully treated by chest-tube drainage; mean age 54 years; 55% with COPD	**Length of hospital stay** 5 days with adding intrapleural instillation of tetracycline 7 days with chest-tube drainage alone	Reported as not significant	⟷	Not significant
[18] RCT **3-armed trial**	96 people treated with chest-tube drainage	**Mean hospital stay** 7 days with tetracycline pleurodesis 6 days with talcum powder pleurodesis 6 days with chest-tube drainage alone	Reported as not significant	⟷	Not significant

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[17] RCT Open-label trial	229 men with pneumothorax successfully treated by chest-tube drainage; mean age 54 years; 55% with COPD	**Adverse effects** with adding intrapleural instillation of tetracycline with chest-tube drainage alone 61/105 (58%) people reported intense chest pain on injection of tetracycline			
[18] RCT **3-armed trial**	96 people treated with chest-tube drainage	**Proportion of people reporting pain** 17/33 (52%) with tetracycline pleurodesis 14/29 (48%) with talcum powder pleurodesis 18/34 (53%) with chest-tube drainage alone	Significance assessment not performed		

Thoracoscopic surgery with talc instillation versus chest-tube drainage:

We found no systematic review. We found one multicentre RCT that compared thoracoscopic surgery plus talcum powder instillation versus chest-tube drainage. [19]

Recurrence rates

Thoracoscopic surgery with talc instillation compared with chest-tube drainage Thoracoscopic surgery with talc instillation seems more effective at reducing recurrence rates at 5 years in people with primary spontaneous pneumothorax (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Recurrence					
[19] RCT	108 people with large primary spontaneous pneumothorax or primary spontaneous pneumothorax that had failed aspiration	**Recurrence rate , 5 years** 3/59 (5%) with thoracoscopic surgery plus talcum powder instillation 16/47 (34%) with chest-tube drainage	P <0.01	○○○	thoracoscopic surgery plus talcum powder instillation

Duration of hospital stay

Thoracoscopic surgery with talc instillation compared with chest-tube drainage Thoracoscopic surgery with talc instillation may be no more effective at reducing the duration of hospital stay in people with spontaneous pneumothorax (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hospital stay					
[19] RCT	108 people with large primary spontaneous pneumothorax or primary spontaneous pneumothorax that had failed aspiration	**Mean hospital stay** 8.0 days with thoracoscopic surgery plus talcum powder instillation 7.4 days with chest-tube drainage	Significance assessment not performed		

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[19] RCT	108 people with large primary spontaneous pneumothorax or primary spontaneous pneumothorax that had failed aspiration	**Pain , first 3 days** with thoracoscopic surgery plus talcum powder instillation with chest-tube drainage Absolute results reported graphically	Modestly, but significantly, increased with thoracoscopic surgery compared with chest-tube drainage	○○○	chest-tube drainage
[19] RCT	108 people with large primary spontaneous pneumothorax or primary spontaneous pneumothorax that had failed aspiration Subgroup analysis	**Pain in people receiving systemic opioids** with thoracoscopic surgery plus talcum powder instillation with chest-tube drainage Absolute results reported graphically	See further information on studies	⟷	Not significant

Video-assisted thoracoscopic surgery versus thoracotomy:

We found one systematic review (search date 2006, 4 RCTs, 353 people) comparing video-assisted thoracoscopic surgery versus open surgery (thoracotomy). [20] The review assessed recurrence rates (see further information on studies) and did not assess other outcomes. Three RCTs identified by the review also assessed other outcomes, and so we have reported these separately. [21] [22] [23] The fourth RCT is awaiting assessment in relation to its coverage of these outcomes. [24]

Recurrence rates

Video-assisted thoracoscopic surgery compared with open surgery (thoracotomy) Video-assisted thoracoscopic surgery may be associated with higher recurrence rates in people with primary or secondary spontaneous pneumothorax, although the difference between groups did not reach significance (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Recurrence					
[20] Systematic review	210 people 3 RCTs in this analysis	**Recurrence rates** with video-assisted thoracoscopic surgery with open surgery (thoracotomy) Absolute results not reported	RR 3.95 95% CI 0.86 to 18.19 The review reported that recurrence rates were higher in people having video-assisted thoracoscopic surgery	⟷	Not significant

Duration of hospital stay

Video-assisted thoracoscopic surgery versus thoracotomy We don't know whether video-assisted thoracoscopic surgery is more effective at reducing the duration of hospital stay in people with primary or secondary spontaneous pneumothorax (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hospital stay					
[21] RCT	60 people with primary spontaneous pneumothorax, either first recurrence or non-resolving first episode In review [20]	**Mean hospital stay** 6.5 days with video-assisted surgery 10.7 days with thoracotomy	P <0.0001	○○○	video-assisted surgery
[22] RCT	60 people; 30 with primary pneumothorax, 30 with secondary, either with recurrence or an air leak persisting for >5 days In review [20]	**Mean hospital stay** 4 days with video-assisted thoracoscopic surgery 5 days with thoracotomy	Reported as not significant May have been underpowered to detect a clinically important difference between groups	⟷	Not significant
[23] RCT	143 people In review [20]	**Length of hospital stay** with video-assisted thoracoscopic surgery (47 people) with thoracotomy (96 people) Absolute results not reported Reported similar and about 7 days with both procedures			

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[23] RCT	143 people In review [20]	**Postoperative pain** with video-assisted thoracoscopic surgery (47 people) with thoracotomy (96 people)	Reported as not significant	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		Absolute results not reported			
[21] RCT	60 people with primary spontaneous pneumothorax, either first recurrence or non-resolving first episode In review [20]	**Use of analgesia** with video-assisted surgery with thoracotomy Absolute results not reported	Reported significantly reduced with video-assisted surgery	○○○	video-assisted surgery
[22] RCT	60 people; 30 with primary pneumothorax, 30 with secondary, either with recurrence or an air leak persisting for >5 days In review [20]	**Use of analgesia** with video-assisted thoracoscopic surgery with thoracotomy Absolute results not reported	Reported as not significant The RCT may have been underpowered to detect a clinically important difference between groups	⟷	Not significant

Chemical versus surgical pleurodesis:

We found no systematic review or RCTs.

Further information on studies

[17] The RCT found no significant difference between groups in 5-year mortality (40/113 [35%] with adding intrapleural instillation of tetracycline *v* 42/116 [36%] with chest-tube drainage alone; RR 0.98, 95% CI 0.62 to 1.38).

[19] The RCT did not establish a protocol for analgesia; 4 centres gave postoperative systemic opioids and three did not.

[20] The review's primary objective was to assess consistency between randomised and non-randomised studies assessing recurrence rates. It found coherence in results with different levels of evidence, namely that video-assisted thoracoscopic surgery was associated with higher recurrence rates.

[22] The RCT reported that 3 people with secondary spontaneous pneumothorax died: 1 receiving video-assisted thoracoscopic surgery and 2 receiving thoracotomy, 1 of whom previously had unsuccessful video-assisted thoracoscopic surgery

Comment: None.

OPTION OPTIMAL TIMING OF PLEURODESIS (AFTER FIRST, SECOND, OR SUBSEQUENT EPISODES)

- For GRADE evaluation of interventions for Spontaneous pneumothorax, see table, p 17 .
- There is no evidence examining when pleurodesis should be given, although there is general consensus that it is warranted after the second or third episode of spontaneous pneumothorax.

Benefits and harms

Optimal timing of pleurodesis:

We found no systematic review. We found no RCTs or high-quality cohort studies comparing pleurodesis undertaken at different times (after the first, second, or subsequent episode/s of spontaneous pneumothorax; see comment below).

Further information on studies

Comment: **Clinical guide:**
One observational study suggested that the 5-year recurrence rate after a first pneumothorax is about 28%, so there may be little reason to perform pleurodesis after the first episode of pneumothorax. [6] There has been consensus that pleurodesis is warranted after the second or third episode of pneumothorax. Even though the probability of success with pleurodesis is high, clinicians will have to weigh the likelihood of recurrence against the morbidity associated with the procedure. Chemical pleurodesis may be appropriate for people unfit or unwilling to have surgery.

GLOSSARY

French gauge A measure of the size of a catheter or drainage tube defined (in France by JFB Charrière in 1842) to be the outside diameter of the tube in units of 1/3 mm. A 12 French gauge tube has an outer diameter of 4 mm. Sometimes the French gauge is called the Charrière (Ch) gauge.

High-quality evidence Further research is very unlikely to change our confidence in the estimate of effect.

Low-quality evidence Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Moderate-quality evidence Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Very low-quality evidence Any estimate of effect is very uncertain.

SUBSTANTIVE CHANGES

Pleurodesis New evidence added. [20] Categorisation unchanged (Trade-off between benefits and harms).

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Disclaimer

GRADE **Evaluation of interventions for Spontaneous pneumothorax.**

Important outcomes			Duration of hospital stay, Recurrence rates, Resolution rates						
Studies (Participants)	Outcome	Comparison	Type of evidence	Quality	Consistency	Directness	Effect size	GRADE	Comment
What are the effects of treatments in people presenting with spontaneous pneumothorax?									
1 (18) [7]	Resolution rates	Needle aspiration versus observation	4	−2	0	0	0	Low	Quality points deducted for sparse data and incomplete reporting of results
3 (194) [8]	Resolution rates	Needle aspiration versus chest-tube drainage	4	−2	0	−1	0	Very low	Quality points deducted for sparse data and incomplete reporting of results. Directness point deducted for differences in definition of outcome
3 (194) [8]	Duration of hospital stay	Needle aspiration versus chest-tube drainage	4	−1	0	0	0	Moderate	Quality point deducted for sparse data
3 (194) [8]	Recurrence rates	Needle aspiration versus chest-tube drainage	4	−2	0	0	0	Low	Quality points deducted for sparse data and incomplete reporting of results
1 (26) [13]	Resolution rates	Small- versus standard-sized chest tubes	4	−1	0	0	0	Moderate	Quality point deducted for sparse data
1 (30) [14]	Resolution rates	One-way valves on chest tubes	4	−1	0	0	0	Moderate	Quality point deducted for sparse data
1 (30) [14]	Duration of hospital stay	One-way valves on chest tubes	4	−1	0	0	+1	High	Quality point deducted for sparse data. Effect size point added for RR <0.5
1 RCT and one trial (93) [15] [16]	Resolution rates	Chest-tube drainage plus suction versus chest-tube drainage alone	4	−3	0	−2	0	Very low	Quality points deducted for sparse data, incomplete reporting of results, and inclusion of controlled clinical trial. Directness points deducted for not stating suction pressures used, and not stating whether primary or secondary spontaneous pneumothorax
What are the effects of interventions to prevent recurrence in people with previous spontaneous pneumothorax?									
2 (325) [17] [18]	Recurrence rates	Adding chemical pleurodesis to chest-tube drainage versus chest-tube drainage alone	4	−2	0	0	0	Low	Quality points deducted for incomplete reporting of results and for open-label RCT
2 (325) [17] [18]	Duration of hospital stay	Adding chemical pleurodesis to chest-tube drainage versus chest-tube drainage alone	4	−2	0	0	0	Low	Quality points deducted for incomplete reporting of results and for open-label RCT
1 (108) [19]	Recurrence rates	Thoracoscopic surgery with talc instillation versus chest-tube drainage	4	−1	0	0	0	Moderate	Quality point deducted for sparse data
1 (108) [19]	Duration of hospital stay	Thoracoscopic surgery with talc instillation versus chest-tube drainage	4	−2	0	0	0	Low	Quality points deducted for sparse data and incomplete reporting of results
3 (210) [20]	Recurrence rates	Video-assisted thoracoscopic surgery versus thoracotomy	4	−1	0	0	0	Moderate	Quality point deducted for incomplete reporting of results

Important outcomes	Duration of hospital stay, Recurrence rates, Resolution rates								
Studies (Participants)	**Outcome**	**Comparison**	**Type of evidence**	**Quality**	**Consistency**	**Directness**	**Effect size**	**GRADE**	**Comment**
3 (263) [21] [22] [23]	Duration of hospital stay	Video-assisted thoracoscopic surgery versus thoracotomy	4	−1	−1	0	0	Low	Quality point deducted for incomplete reporting of results. Consistency point deducted for conflicting results

We initially allocate 4 points to evidence from RCTs, and 2 points to evidence from observational studies. To attain the final GRADE score for a given comparison, points are deducted or added from this initial score based on preset criteria relating to the categories of quality, directness, consistency, and effect size. Quality: based on issues affecting methodological rigour (e.g., incomplete reporting of results, quasi-randomisation, sparse data [<200 people in the analysis]). Consistency: based on similarity of results across studies. Directness: based on generalisability of population or outcomes. Effect size: based on magnitude of effect as measured by statistics such as relative risk, odds ratio, or hazard ratio.